be conceived that in wet seasons the oozing waters will have some difficulty in making up their minds whether to take their course to the Atlantic, the Indian Ocean, or by the Cubango south to the sands of the Kalahari Desert. Major Pinto's real starting-point was Bihé, the eastern limit of Portuguese West Africa. Going south and east by the Kalahari Desert, through the Transvaal, he came upon the scene of the Anglo-Zulu strife, and was safely carted to Durban. He suffered the usual hardships of desertion by followers, starvation, fighting hostile tribes, and narrow escapes from cataracts. To the west of Bihé he discovered the source of the Cubango, which, he states, loses itself in the Kalahari Desert, after overflowing to form Lakes Ngami and Macaricari, the latter of which is sometimes dried up. There is no connection, he says, between the Cubango and Cuando, the latter, after receiving many feeders, finding its way to the Zambesi, where, at its mouth Livingstone gave it the name of Chobé. A good deal of his information Pinto seems to have derived from a map drawn by a Bihé native. The river Cuqueima, he tells us, is an affluent of the Coanza, west of the Cubango. At its source the Cuando is a little rill, but soon becomes navigable, many of its tributaries being navigable also. Going through Ungo-é-Ungo, between the Cuango and Upper Zambesi, he found the ground all miry, an immense marsh; "water covered everything." From the Bihean's map he found that the most southern source of the Lualaba lies between those of the Liambai, or Zambesi, and the Luengué, and in 12° S. lat., "like those of the other rivers of Africa." The Luengué, or Cafuque, the "Cafue" of Livingstone, a tributary of the left bank of the Zambesi, the Major states, has not a single cataract, and should form the real key to Central Africa. The river that connects Lakes Bangweolo and Moero, he states, is not the Lualaba, but the Luapula; did not Livingstone say so? Lualaba, Pinto says, is the name given to the west arm, which extends to 12° south, and must be considered the real source of the Congo, and not the Chambeze, which enters the east end of Lake Bangweolo. On a recent map of Africa, we find the Lualaba placed as described, and as to which is the source of the Congo, it is a matter of opinion as to what "source" means.

The Zambesi seems to be more notorious for cataracts than even the Lualaba—Congo; Pinto and his men descended thirty-seven; he saw thirty in the space of an hour and a half "that had never been mentioned by any one."

At the junction of the Cuando and Zambesi, Major Pinto found an English naturalist from the Cape, Dr. Bradshaw, "who was reduced to the greatest misery," wandering about barefoot, and carrying in his hands a pair of shoes, with only a tattered shirt and a pair of trousers on. Dr. Bradshaw's extreme misery he seems to have borne with equanimity; he gravely presented his carte-de-visite, taken in London, to his Portuguese fellow-explorer. He was shooting birds and collecting animals for "the English museums." Near the same place a French missionary family befriended the sorely beset traveller, and helped him out of his difficulties. At the beginning of his journey, at Caconda, he met another naturalist, a Portuguese, Anchietta, who has been twelve years in Africa, and "has enriched one of the best African museums in the world, that of the Lisbon Polytechnic School, which is under the direction of Dr. Bocage." Have the treasures of this African Museum ever been described? Anchietta was more fortunate than the miserable English naturalist, who received the major in his drawers. The Portuguese, on the contrary, received his compatriot "in the woods, wearing a white necktie and a dress coat, and offered us tea in cups of porcelain of Sèvres." Still Anchietta, with all his attention in the wilds of Africa to the usages of ceremonious Europe, seems to be a hard-working naturalist.

The only other point in Major Pinto's lecture we need notice is his observation as to a race of white Africans, which will recall to the reader what Stanley says about the white inhabitants of the lofty mountain near the Albert Nyanza. We shall let the Major tell what he observed for himself:—

"I one day noticed that one of the carriers was a white man. He belonged to a race entirely unknown up to the present day. A great white people exists in South Africa. Their name is Cassequer; they are whiter than the Caucasians, and in place of hair have their heads covered with small tufts of very short wool. Their cheek-bones are prominent, their eyes like those of the Chinese. The men are extremely robust. When they discharge an arrow at an elephant the shaft is completely buried in the animal's body. They live on roots and the chase, and it is only when these supplies fail them that they hold any relations with the neighbouring races, the Ambuelas, from whom they obtain food in exchange for ivory. The Cassequeres are an entirely nomadic race, and never sleep two nights in the same encampment. They are the only people in Africa that do not cook their food in pots. They wander about, in groups of from four to six families, over all the territory lying between the Cuchi and the Cubango. It would seem that from a crossing of the Cassequeres with the negroes of other races, sprang those mulattoes of the South whom the English call bushmen. The latter are, however, better off than the Cassequeres, and use pots in cooking their food, while their dispositions are good, though quite opposed to civilisation."

We cannot doubt the accuracy of the Major's observations, though we should require to know more of the curious people he speaks of before pronouncing on their origin and affinities.

Altogether it will be seen that Major Pinto, while hardly having a claim to be ranked among "the foremost of explorers," has done a piece of good and useful work amid a good many dangers, work creditable to himself and his country, which, we trust, will be stimulated by his example to do what she ought for the complete exploration of that part of Africa which forms, so to speak, the back garden of her West Coast colonies.

THE COMPARATIVE ANATOMY OF MAN[1]

I.

HUMAN anatomy, as ordinarily taught, has for its end simply the knowledge of the structure of the body of the man we have most to deal with in our practice, that is, the European man, in his usual average development. No cognisance is taken of the deviations from this ordinary but known type, except as individual variations, which have their principal interest in any interference they may cause with our diagnosis or treatment of the diseases or injuries to which our frame is liable.

The comparative anatomy of man goes beyond this. Instead of aiming at describing a general average man, by overlooking, or purposely eliminating, all deviations from the normal standard, it is specially occupied in studying the differences between one man and another, estimating and classifying these differences, and especially discriminating between such differences as are only individual variations (variations which, when extreme, are relegated to the department of the teratologist) and those that are inherited, and so become characters of distinct groups and races of the human species. Physical anthropology, moreover, extends its range beyond merely comparing and registering these differences of structure. It also occupies itself with endeavouring to trace their cause, and the circumstances which may occasion their modifications. It endeavours, also, to form a classification of the different groups of mankind, and so to throw light upon the history and development of the species' These are all exceedingly difficult and complicated problems.

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[1] Abstract of Prof. Flower's Hunterian Lectures, delivered at the Royal College of Surgeons, commencing on Wednesday, March 5.

As an example of one of the problems which the student of the Comparative Anatomy of Man sets himself, may be quoted the relation of the size of the brain to that of the rest of the body in different races and different individuals. An important contribution to this much-vexed question appeared in the last number of the French *Revue d'Anthropologie*, by M. Gustave Le Bon, in which the author, among other things, endeavoured to show that in lower races, and uncivilised conditions of the higher races, the brains of men and women were comparatively equal in size and weight, but that with elevation in the scale and advance of culture, the differences between the sexes increased, the women's brain remaining stationary, while that of the men augmented. There are, however, some fallacies in the statistics quoted in support of this proposition, which might apply to the women of France, although not to so great a degree as M. Le Bon seems to imply. The lecturer showed that in England, according to the best information yet obtained, the proportional size of the female brain to the male was as 9 to 10, very nearly the same as in the lowest and least cultivated of the races quoted by M. Le Bon.

As regards the relative size of the head in men, it seems probable from the investigations of Mr. Francis Galton and others, that on the whole men with the greatest amount of intellectual capacity have large heads, although this is by no means always the case. Small heads are frequently accompanied by great energy.

The Australians were described in last year's lectures, but as they are a very interesting race, being both socially and physically the most different from ourselves, it may be as well to go over some of their principal characters again.

Their habits are very primitive, their only domestic animal being the native dog, and their only weapons the boomerang, spear, and lance, having no bows and arrows. They have not acquired the art of pottery making. One of their principal characteristics is the small size of the brain-cavity compared with that of a European, the largest not coming up to the size of the average Italian peasant. Since last year five Australian skulls have been added to the museum, which are all extremely characteristic of the race. The average capacity of these five is 1,234 c.c., while the average of five ordinary European skulls is 1,574 c.c.

Another characteristic of the skull is that it is long and narrow; the cephalic index, or relation of the greatest breadth in the parietal region to the extreme length, which is taken as 100, being on the average 71 or 72. The super-orbital ridges are extremely pronounced, and the orbits are elongated, and short from above downwards. The nose is short and wide below, and the jaws project forwards. The skin of these people is dark, and their hair is black, but not curly.

The Tasmanians are in some respects allied to the Australians, and in others differ greatly from them.

Tasmania was discovered in 1642 by Abel Tasman, but it was not until 1777, when Capt. Cook visited it, that the intercourse between the English and the Tasmanians commenced. In 1803 it became an English colony. The race is now entirely extinct, the last man having died in 1869, and the last woman in 1876.

Unfortunately, but few skulls have been preserved, and we have very little information about this curious and interesting race. Their habits seem to have been very primitive; they had no domestic animals, not even the native dog, and no boomerang, their only weapons being a lance and a club or "waddy."

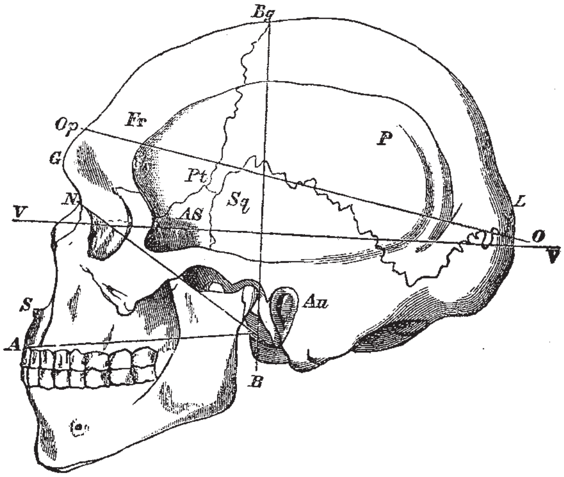
The skull is very characteristic, the parietal part being broader than in that of the Australians, and the hair is woolly, something like that of a negro, a microscopic section showing it to be flattened and elliptical, while straight hair is more or less cylindrical. They have probably been isolated from all other races for a great length of time, though it is likely that Australia was once inhabited by a people resembling them.

The islands of the Pacific Ocean proper are inhabited by two extremely distinct and different races, which are, however, often much intermixed. One of these, the Papuans or Melanesians, are very like negroes, having woolly hair, broad noses and mouths, and low orbits; the skull is long and narrow, and more like the Australian type. The other—the true Polynesian—of which the Samoans and Tongans may be taken as the best types, have more or less straight hair, and in many respects resemble the Malays; their heads are round, and they have a fine high face, with a long and narrow nose and a round short mouth. These latter are much more highly civilised than any of the races described above; when they were discovered, at the end of last century, they had houses, clothes, domestic animals, canoes, &c.

It seems very probable that these islands were once inhabited much more extensively by Melanesians, the Polynesians having colonised those which extend from the Sandwich Islands, on the north, to New Zealand, on the south, and having in most cases replaced the original race. Mixtures have also taken place, as in the Maories of New Zealand.

A few details must now be given about the methods of measuring the capacity of crania. This is a much more difficult operation than might at first sight be supposed. The best method seems to be that used by Mr. Busk, viz., filling the skull with rape or mustard seed, which is then measured with an instrument called a choremometer. It should always be filled to a maximum, a funnel of a certain aperture being used, and the seed being well shaken and pressed in, as a difference of three or four cubic inches may be made if these precautions are not attended to.

The capacity of a skull, as well as its extreme dimensions, varies much in proportion as it is wet or dry. One which measured 520 linear millimetres in circumference in summer increased 7 millimetres in winter.



Side view of skull of male Australian. *VV*, horizontal line, corresponding with visual axis; *A*, alveolar point; *S*, spinal point, or base of nasal spine; *N*, nasion, or centre of fronto-nasal suture; *G*, glabella; *Op*, ophryon, or centre of super-orbital line; *Bg*, bregma, or union of coronal and sagittal sutures: *L*, lambda, or union of lambdoid and sagittal sutures; *O*, occipital point; *Au*, auricular point, or centre of external auditory meatus; *B*, basion, or centre of anterior margin of foramen magnum; *Pt*, ptereon, or point where the frontal (*Fr*), parietal (*P*), squamosal (*Sq*), and alisphenoid (*AS*) bones meet.

The circumference of a skull is taken by passing a tape round it from a point called by Broca the *ophryon*, which is the centre of a line taken just above the supra-orbital ridge or glabella, to the *occipital point*, or most prominent point of the occiput. The division commonly made between the anterior and posterior parts of the skull is by a line drawn from the middle of the external auditory meatus, or *auricular point*, to the *bregma*, or point where the coronal and sagittal sutures meet. The skull of a gorilla differs greatly from that of a European in the diminution of the portion situated behind this line, and the Australian cranium approaches the former where it differs from the latter, the posterior half being smaller than in the European.

The facial angle, or angle made by the profile with a horizontal line, is obtained by placing the skull in such a position that the axis of vision is horizontal. This is done by passing a rod exactly through the centre of the anterior opening of the orbit, and through the optic foramen. By means of a square, the amount of projection in front of or behind any given point can then be ascertained.

The three points forming what is known as the facial triangle are the *basion*, or centre of the anterior margin of the foramen magnum, the *nasion*, or centre of the fronto-nasal suture, and the *alveolar point*, or middle point of the upper jaw. The length is usually taken from the ophryon, but some take it from the glabella. The breadth is the greatest breadth in the parietal region.

Narrow skulls are called *dolichocephalic*, and broad ones *brachycephalic*. Taking the length as 100, if the index of breadth is above 80 the skull is brachycephalic; if below 75, dolichocephalic; while if it lies between these numbers it is called *mesocephalic*.

The height is taken from the basion to the bregma.

The form of the orbit varies much. The orbital index, or relation of the length (taken as 100) to the breadth, is very low in the Australians, the average being about 80. The form of the nose is characteristic both in races and individuals; the width compared with the height gives the nasal index. This varies much in individuals, but general averages are very important. The average nasal index of Australians is 57. Broca calls those races whose nasal index is lower than 48, *leptorhine*; between this and 53, *mesorhine*; and above 53, *platyrhine*.

The name *metopic* has been given by Broca to those skulls in which the suture between the frontals remains open in the adult. It generally closes up at the end of a year or two, and if it does not unite then, it rarely does afterwards. In European races this metopism is seen in about one cranium in ten, while in Australians and other low races it is extremely rare, as in monkeys.

The different races of men have been classified into two great groups according to the character of the hair, viz., the *Ulotrichi*, or woolly-haired people, and the *Leiotrichi*, or smooth-haired people. Mr. Charles Stewart has shown that, besides the difference in the microscopical structure of woolly and straight hair already mentioned, there is a difference in their mode of growth. The follicle in which an ordinary hair is developed is straight, while in the case of woolly hair it is curved, thus giving the hair a spiral twist. The woolly-haired people inhabit the greater part of Africa, and also a chain of islands extending from Tasmania to New Guinea and the Andaman Islands. These latter, or oceanic negroes, differ considerably from the former, or African negroes, and also differ very much among themselves. They may be divided into two distinct branches, an eastern and a western, and it is very difficult to determine whether they all arose from the same stock. In the eastern branch the people are nearly all characterised by high, narrow heads, much compressed at the sides, and features resembling the Australians.

The Museum of the College of Surgeons has lately received an interesting addition to the collection, viz., a dried man, painted red and otherwise ornamented, and fixed on a sort of hurdle, which was found in a hut on Darnley Island, in Torres Strait. The head of this man is less dolichocephalic than that of most Papuans, but it had probably been artificially compressed in infancy, many of these people having this peculiar custom. The mouth is large and projecting, but the nose is better formed than in the Australians.

When the Spaniards took the Philippine Islands they found them chiefly inhabited by Malays, but also in the wilder parts by a small race which they named Negritos. These have black complexions, woolly hair, and negro-like features. They perhaps extend as far north as to the south of Japan, but they are best marked in the Andaman Islands, where the race retains its purity.

The Andaman Islands consist of a long narrow chain of four principal islands, the Great Andamans, separated by narrow channels, as well as some smaller ones, called the Little Andamans. The first reliable notice of these islands is by some old Arab voyagers in the 9th century. No European traveller visited them until the end of last century. In 1788 a convict station was established at the south end, at a place which was called Cornwallis. This was soon abandoned, and another settlement made on the north. This, again, however, was given up, and it was not until November, 1857, that the Government once more took up the question and established a settlement on the site of Cornwallis, which is now called Fort Blair. For four or five years the natives were very shy, and the accounts of them are very unsatisfactory. They are now, however, becoming civilised, the English governors having built houses for them, and allowing them a certain quantity of food.

Although this chain of islands is only about 140 miles long, there are as many as nine distinct tribes speaking different languages. During the last year Mr. Man has sent over a valuable collection of their manufactures, and these show that in some respects they occupy a higher grade of civilisation than the Australians, Tasmanians, &c.

In the Little Andamans the people built beehive-like houses, but in the Great Andamans they had no permanent houses or clothes, the substitute for the latter being a thick coat of mud and pig's grease. A good deal of taste is shown in the manner in which this clothing is ornamented, one man being seen with half the body red and the other half yellowish, and ornamented by zigzag lines. A favourite ornament is a necklace made of the finger-bones of deceased relatives.

The Polynesians have a very general custom of preserving the bodies both of friends and enemies; the Borneans preserve their enemies, but the Andamanese give the preference to their friends. A widow often wears her husband's skull round her neck as an ornament.

The Andamanese do not cultivate the ground, but they are very expert with the bow and arrow. They cook their food, which consists principally of wild pigs and fish. They make canoes, hollowed out of the trunks of trees, and also a rough kind of pottery, simply moulded by the hand. There is no proof that they ever practised cannibalism, notwithstanding the frequency with which the charge has been brought against them.

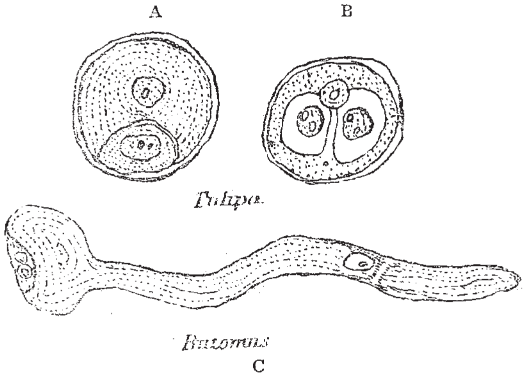
There is much difference in the descriptions of travellers of the features and general characters of these people; some say that they are all very much alike, and others that they vary considerably both in form and features and character of hair, which is usually extremely black, close, and woolly. A section shows it to be nearly as flat as that of a South African Bushman. They, however, generally keep their heads shaved. All photographs hitherto sent to Europe show a very close general resemblance. The head is round, the forehead broad and upright, the nose small and straight, and the lips not very thick or projecting. They are a very small race, the average height being under five feet, the women being shorter than the men. There are, in fact, only three other races which are equal or approximate to them in smallness, viz., the Bushmen, the inhabitants of Tierra del Fuego, and the Lapps. The name of *Mincopie* has often been applied to these people, but it does not appear to be now used in the islands.

(*To be continued.*)

ON POLLEN PLANTS

THE evolution of the vegetable cell—using the word evolution as defined by Herbert Spencer—is a subject of immense interest that is now engaging the attention of some of the most scientific of the botanists. While the important researches of Carl Nägeli on cell-structure and cell-development can never be over-estimated, yet in these more recent times we are greatly indebted to the original and remarkable researches of Eduard Strasburger, which have thrown a flood of light on the subject, and opened out for it new and as yet untrodden by-paths. His thoughtful work, "Ueber Befruchtung und Zelltheilung," ought to be in the hands of every student. It is not here purposed to analyse the contents of this volume, now more than eighteen months on our shelves, but in it, we fear somewhat overlooked, we find the subject of the cellular-structure of the "pollen grains" in the angiosperms first mentioned, at least, in very recent times, and we are glad to perceive that the facts relating thereto have been recently restudied, and in some detail, by Fredr. Elfving, of Helsingfors, under the eye of Strasburger, and in his physiological laboratory at Jena.

We adopt for convenience the ordinarily received division of plants, in which the flowering plants, or those having the sex-cells developed in connection with phyllomes, are separated from the so-called flowerless plants, in which the sex-cells are formed on thallomes. All the more recent manuals of botany assert that the two groups of the former, the gymnosperms and the angiosperms, are differentiated, the one from the other, by certain striking peculiarities relating to their reproductive systems. One of these is that in the former the pollen-grains are multicellular, and that in the latter the pollen-grains are unicellular, a nice, and it ought to be an easily ascertained distinction, but unfortunately one that turns out on investigation not at all true. In the pollen-grains, or, as we would prefer to call them, the pollen-plants of the gymnosperms, there are all the essentials of an adult and independent form, that is to say, the protoplasmic contents of the pollen plant divide into two or more cells, of which one takes upon itself the growth and functions of the pollen tube, and the other remains with no such functional power, but at most plays the feebler part of a vegetative cell. There is thus, as it were, a thallus formed, one cell of which performs the function of an antheroidal or male cell. All this has been for some time known to be the case in the gymnosperms of which our cone-bearing trees and shrubs may serve as familiar types; but in the angiosperms, embracing nearly all our showy flowering herbs, shrubs, and trees, despite Strasburger's researches published in 1877, it is still most generally stated that inside the inner coat of the pollen-grain there is but a single protoplasmic mass which gives rise to the pollen tube. So far as this difference in the pollen goes, it will now probably not be again insisted on, for a glance at the very copious figures drawn from nature by Mr. Elfving will satisfy the most sceptical that the angiospermous pollen-grain is really a compound body, entitled to rank as a thallus, and in which, as in the gymnosperms, there are both functional and vegetative cells. The researches culminating in this memoir were chiefly made during the summer session of 1878 in the Botanical Institute at Jena. The pollen was cleared by means of a 1 per cent. solution of osmic acid, and then stained and preserved in a carmine-glycerine fluid. If the outer coat be not too dense, the contents can be seen through it after from one to two days' steeping in osmic acid. In order to see the growth of the pollen tube, recourse must be had to artificial culture; for this purpose many sorts of solutions were used, and these of very different degrees of condensation, but in the end the author came back to a simple solution of 1 to 25 per cent. of sugar. Some pollen plants required but weak solutions, others strong ones. The strength of the solution found in certain cases most useful is given in the details of the experiments. The culture upon most were generally made in the dark, and at a summer temperature, but some grown in daylight succeeded admirably. The orchids are referred to as affording most excellent subjects for these investigations. On three plates the different forms of pollen-plants to be met with in some twenty-three species of plants are represented. Of these we select that of *Tulipa gesneriana*, in which the vegetative cell happens to be very large (A in figure), and it very frequently divides, as seen at B, also that from *Butomus umbellatus* (C), showing the vegetative cell and the tube. In this figure the side walls are not represented. The chief results of these researches are collected together as follows:—The pollen-grain in the angiosperms becomes divided into two cells, generally a larger and a smaller one; the latter, the "vegetative" cell, by a further division, becomes developed into a two- or often a three-celled thallome. This vegetative cell, or these vegetative cells, are only separated from the larger cell by a wall of cortical plasm, (ectoplasm, Vines), but this, in particular instances, can become formed into a firmer membrane (cellulose?). The pollen tube is the result of an outgrowth of the larger cell.



In the gradual growth of this it may happen that the vegetative cell or cells will wander into the pollen tube, the wall of the larger cell having become obliterated, or they will remain free in the cavity of the mother-cell, often becoming spindle or half-moon-shaped.

The nuclei are often peculiarly fashioned, but with the exception of the Cyperaceæ no instance of a division of the nucleus of the larger cell was observed.

All the pollen plants described by Elfving belong to the sections either of the "wind-wafted" or the "insect-borne" forms. The study of the structure of the pollen plants of such cleistogamous flowers as those recently described by Bennett, such as some of the violets, wood sorrel, &c., may reveal some interesting facts. In them there would seem to be a greater individuality; the very behaviour of their pollen tubes is so different that they would appear as if they had a more independent basis; but this is rather a subject for research than for conjecture. In the meanwhile we may note how many apparently sure landmarks have been, in the botanist's country, lately thrown down by the researches of Warming, Strasburger, and now Elfving. It will be difficult by and by to invent neatly-